

Description

Electronically controlled electric motor intended for
use in an environment with solvents

The invention relates to an electronically controlled electric motor intended for use in an environment with solvents, with at least one rotor bearing permanent magnets and a stator having coils, in which motor position sensors for ascertaining a commutating time are arranged in the stator.

Such electric motors are often referred to as electronically commutated DC motors and are used, for example, in fuel tanks for driving a fuel pump. If the coils are arranged in the stator, the electric motor does not require any carbon brushes for the transmission of electrical energy. The electric motor is consequently distinguished as an inexpensive drive with a long service life in the lower and medium power ranges. Hall sensors are generally used as position sensors. The Hall sensors have semiconductor chips with terminal contacts. The semiconductor chips and the terminal contacts are usually sheathed in plastic. The disadvantage of the known position sensors is that the semiconductor chips are of a very complex construction due to their sheathing. Furthermore, the semiconductor chips, soldering points of the terminal contacts are not solvent-resistant in the long term. Plastic sheathings also cannot offer adequate protection against the diffusion of solvents, so that, in spite of sheathing, the semiconductor chips are attacked by the solvents. These occurrences of damage to the semiconductor chips mean that the position of the rotor can no longer be reliably sensed by the position sensor.

The invention is based on the problem of designing an electric motor of the type stated at the beginning in such a way that it can be produced as

inexpensively as possible and has a very high resistance to solvents.

This problem is solved according to the invention by the position sensors having an electrical conductor which is induced by a moving magnetic field to generate a signal and by the electrical conductor being produced integrally with connecting leads.

This design obviates the need for the position sensor of the electric motor according to the invention to have any sheathing, since an electrical conductor, such as a copper wire for example, is not attacked by solvents. As a result, particularly inexpensive position sensors can be used in the electric motor according to the invention. The integral production of the electrical conductor with the connecting leads also allows the position sensor to be fitted very easily and not to require any solvent-resistant soldering points. The electric motor according to the invention can consequently be produced particularly inexpensively and has a very high resistance to the solvents. A further advantage of this design is that the position sensor can be arranged very close to the magnet of the rotor, so that the position of the rotor can be determined particularly exactly.

The connecting leads of the position sensor could, for example, be screw-connected to continuing leads, to avoid soldering points which are not solvent-resistant. However, the fitting of the electric motor according to the invention is made even easier if the connecting leads of the position sensor are led to a solvent-free space. In the case of the electric motor intended for driving the fuel pump arranged in the fuel tank of a motor vehicle, the connecting leads can consequently be led to outside the fuel tank.

According to another advantageous development of the invention, the position of the rotor can be determined particularly exactly if the electrical conductor is designed as a coil. For this purpose, the

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The first of these is the fact that the
 \mathcal{H}^1 norm is not a norm on the space of
 functions of bounded variation. This is
 because the norm is not positive definite.
 For example, if f is a function of bounded
 variation, then $-f$ is also a function of
 bounded variation, and $\|f\|_{\mathcal{H}^1} = \|-f\|_{\mathcal{H}^1}$.
 This means that the norm is not able to
 distinguish between a function and its
 negative. This is a problem because it
 means that the norm is not able to
 capture the full information about the
 function.

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on a rotatably mounted shaft 2. The rotor 3 has a plurality of coils 5 opposite permanent magnets 4 of the rotor 3. The coils 5 are fastened in the housing 1. Position sensors 6 for sensing the position of the rotor 3 are arranged between the coils 5. On the basis of the signals of the position sensors 6, electric current fed to the coils 5 is controlled. The electric motor is often referred to as an electronically commutated DC motor. The position sensors 6 have in each case electrical conductors 8 produced integrally with connecting leads 7 led to outside the housing 1. On the outer side of the housing 1, the connecting leads 7 are connected to terminal contacts 9. At these terminal contacts 9, control electronics (not represented) of the electric motor can be connected. The electrical conductors 8 are wound to form a coil. When there is a rotation of the rotor 3, the permanent magnets 4 generate induction currents within the electrical conductors 8 wound to form the coil. The electrical conductors 9 are produced, for example, from copper wire.

Figure 2 schematically shows a further embodiment of the electric motor, in which the position sensors 6 have electrical conductors 10 designed as pulse wires. The electrical conductors 10 are arranged parallel to the lateral surface of the rotor 3 and are produced integrally with connecting leads 11. As in the case of the electric motor from Figure 1, the position sensors 6 are arranged between the coils 5.

Figure 3 schematically shows a further embodiment of the electric motor, in which a disk 13 having position magnets 12 is fastened on the shaft 2 away from the permanent magnets 4 of the rotor 3. The position sensors 6 are opposite the disk 13 with the position magnets 12 and are consequently located in a position remote from the coils 5. The position sensors 6 have electrical conductors 14 wound to form a coil.

Figure 4 schematically shows a further embodiment of the electric motor, in which the position

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